Developing a design system for an e-commerce website

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Master of Arts thesis abstract

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Abstract

This thesis consists of a theoretical framework on design systems including a benchmark analysis and a production project to develop a design system for an e-commerce website. The objective of the research is to explore whether a design system is a tool that is not only useful to be used by large teams but also for small teams. The research is based on the analysis of the positive and negative effects that a design system may have if employed by small teams vis-à-vis larger teams.

The thesis is written from a UI/UX designer's perspective and focuses on the following three aspects of design system: design studies, design practice, and design exploration. The design studies dive into the fundamental elements of design system, its history and the common practices of how it operates. In order to explore design practices, a benchmark analysis is conducted on two existing design systems developed by larger e-commerce companies. It demonstrates the process and results of larger teams that have integrated a design system into their product development process. For design exploration, the author worked on a production project to develop a design system for an e-commerce website that fits the requirements of a small team.

Finally, this thesis provides a set of recommendations for designers on how to develop a design system tailored to be used in small teams. It highlights that while design systems are commonly being employed by large organizations, the development of design system management tools, enables smaller teams to employ design systems that are manageable in order to accelerate productivity.

Keywords Design system, E-commerce, User interface, User experience

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1. Introduction

UI / UX designers are continuously looking for different approaches to make digital content creation more systematic and collaborative. A design system facilitates this process when developing a digital product by documenting information that is not only useful for the designer themselves but also for other designers, developers, content creators, marketers and other stakeholders. However, a design system is more than just a mere visual guide and a component library as it can include, inter alia, a brand identity, design principles, user experience best practices and functional and technical documentation. As such, it allows members of the product development team to foster synergies between team members through sharing information, which in turn helps to collaborate more efficiently.

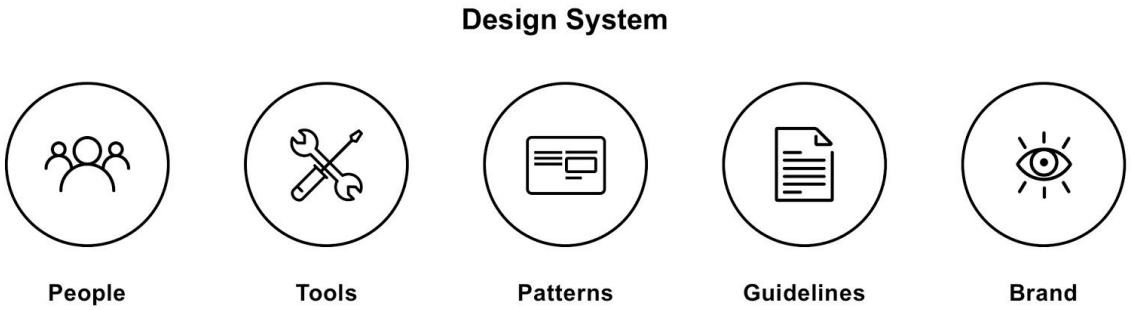

Figure 1. A design system is a unification of various tools, resources and guidelines.

The approach to digital content creation and requirements of the designer has evolved over time mainly due to technological advancements. In particular, digital products have become more sophisticated due to increased expectations for web services. Product development teams are often required to create interfaces for multiple screens, various devices, different platforms and for more users. In addition to this, the production cycle is shorter than ever before resulting from increased customer demands. When existing design tools fail to fulfill these requirements, introducing a new way of working becomes necessary.

During the past few years, many companies have started to develop their own design system and incorporated this framework as part of their product development process. In particular, design systems are known to be well-suited for large teams or projects with multiple stakeholders to co-create more efficiently. The benefits of using design system that fits the specific requirements of smaller teams with limited resources are less apparent and yet to be

explored, however. The curiosity to explore the answer to this question is what motivates this thesis.

1.1 Background

I was first introduced to the concept of design system during the Nordic designer conference in Stockholm in 2017. After listening about the benefits of incorporating a design system into the product development process, our team became very excited and decided to start building one on our own. However, as the only designer in the team, I felt intimidated by the idea of how much time and resources it might require to build a design system as sophisticated as the ones for instance developed by IBM or Airbnb have developed. It seemed like a design system is an ideal tool well suited for larger organizations to streamline its complex development process. However, for a small team like ours, was it even worth the effort to change the way how we work; and with time, resource and budget constraints, is there a way to develop a design system that is both dynamic and manageable?

Against this backdrop, this study explores the term design system, its definition, common frameworks and the history of how design systems have evolved from simple visual guidelines to becoming sophisticated tools used in many large organizations. While we discover that design systems help accelerate the design process, it also reveals that a systematic way of working may set limitations for creativity. As such, this study analyses the merits of design systems and the potential drawbacks it might have.

The data to support the findings are collect through benchmarking design systems that are developed by e-commerce companies and comparing it to my own experience of building a design system named ‘’Oxygen’’, as a single designer working in a small team. To elaborate on this, the research is conducted by performing a case study analysis on an existing project to build a design system for an e-commerce website that fits the requirements of a small team. The case study focuses on the development process and aims to provide an analytic view of the advantages and disadvantages of using a design system in a small team. It concludes with recommendations for developing design systems that are suited for smaller teams.

1.2 Research questions

A design system helps the design process to be faster, easier and more collaborative. It helps to make digital products to be more adaptive and to grow. However, it might be more difficult for a smaller team with resource, budget and time constraints to build a design system. Another critical factor to consider is whether a design system is as beneficial to a small team as to a large team.

Against this background, the following three research questions have been developed for this thesis:

1. ***Is a design system only useful for larger teams?***

2. ***What are the advantages and disadvantages for small teams of using a design system in the design process?***

3. ***How to build a design system to make fit for use for smaller teams?***

1.3 Scope of research and project

This thesis aims to provide fundamental knowledge on design system by focussing on its definition, history, application and best practices. The term design system in this study refers to the tool, framework, and methodology being used in the digital product development process. The digital products examined in this study are, inter alia, websites, web applications, mobile applications and modern consumer's digital products.

The case study presents a perspective on design systems based on my own experience of developing a design system to design an e-commerce website, and aims to inform all members of the digital production team and in particular, user interface, interaction and user experience designers, who consider to incorporate a design system method into their digital production process.

The information presented in this thesis is written from a design perspective. Thus, other technical areas such as information architecture and front-end code library are not the focus of this study.

2. Theoretical background

The purpose of this chapter is to set out the theoretical framework of this thesis by reviewing relevant literature on design systems, and the methods used to implement a design system. It analyzes the design systems from different aspects ranging from color, typography, pattern library and design principles to more operational aspects such as system parameters that form the foundation of the design system.

Furthermore, this chapter reviews common approaches towards the design system in order to take into account multiple views for the case study analysis presented in chapter 4 of this thesis. The aim is to establish comprehensive theoretical framework, which is used to support the process of implementing a design system for an e-commerce website.

This chapter also analyzes different examples of e-commerce websites which have incorporated a design system with the purpose to compare the effectiveness of design systems for larger teams vis-à-vis smaller teams in the context of project development. The collected data is used to support the case study analysis.

2.1 Introduction to the term: design system

At the start of the internet era, the internet was used as a means to share information that was originally printed on paper. Nearly three decades later, the world has undergone a digital transformation resulting from the emergence of social media and the growth of the e-commerce industry, for instance. This digital transformation has changed the way how people interact and communicate on an unprecedented global scale. As a result, requirements to develop the digital world have surged to a new high.

Software developers have, however, experienced a hard time catching up with this rapid digital transformation. In particular, increased workloads and shortened development cycles

make development teams often struggle. As such, finding a more efficient way to improve product consistency is a common goal that product development teams are often trying to achieve. In this context, there is a concept that is constantly brought up and starting to mature to improve the web experience namely, modularity.

The concept of modularity exists long before the invention of the internet. During the industrial revolution, Henry Ford's assembly line and standardized automobile parts revolutionized the way how the car industry manufacturers cars.

In addition to industrial design, a similar concept has been applied to architecture. Christopher Alexander published in 1977: A pattern language: Towns, Buildings, Construction. A book covering architecture and urban design in which patterns to common problems are described and to which solutions are offered in order to avoid making similar mistakes. It enabled non-professionals to collaborate with each other to improve the infrastructure of a town, neighborhood or a house by themselves (Alexander, Ishikawa & Silverstein, 1977). Followed by this book, Christopher Alexander published in 1970, The Timeless Way of Building, in which he elaborates on the philosophical background of the pattern language proposed in his earlier publication (Alexander, 1979), which in particular had a profound influence on design thinking within software design and architecture industry.

The essence of modularity, pattern language, and design system are similar, namely to establish a standardized workflow or toolkit that improves production efficiencies and consistencies.

Despite design systems being a concept that is often talked about in today's digital age, to define the term itself remains to be challenging. When searching the web, there are numerous versions of definitions, which result primarily from the field being in constant development.

A design system is also difficult to define as it is not an entirely new invention. Many people might confuse it with a style guide. However, a style guide is considered to be the output of the design process. Sarah Federman (Federman, 2017) proposed an analogy that compares design system to whiskey. She described the design system as the distillation of tools and methods that have been around and used in the production process. What makes a good bottle of whiskey is its resources (the soil and master distiller) and the operation (aging and

distillation process). Subsequently, the emotion that the whiskey invokes in people creates an experience.

Resources + Operations outputs **Product**

Product + Emotion creates **Experience**

Figure 2. Sarah Federman's analogy of how design system operates similarly to the whiskey distillation.

Generally, there are two common ways to define a design system. One way is to view the design system as a methodology (i.e. the method used to design the product). Another way is to define the design system as the product. In other words, all tangible elements such as documentation, the UI kit, code repositories and the design system operations that make the design system work (See figure 3 and 4).

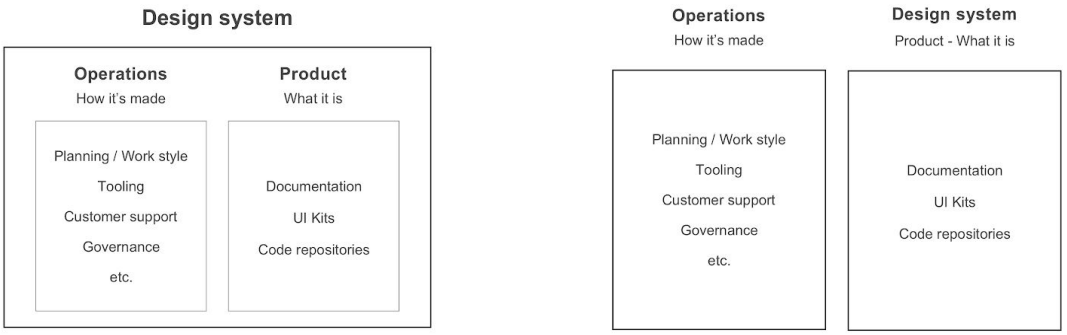

Figure 3. Left: Design system as the methodology. Right: Design system as the product. Image from (Federman, 2017).

Figure 4. The same model as figure 3, however, in the context of the given analogy. Image from (Federman, 2017).

From a technical perspective, the definition of design system leans towards the latter where a design system represents tangible products. Curtis (Curtis, 2015) defines the design system as usually consisting out of visual documentation and a component library that generates reusable code for the developer and tool(s) for designers. Also, it may provide guidelines for accessibility, page layout and editorials such as voice and tone. Rarely it is about branding, data visualization, UX patterns or other tools. It is created by a particular person, team or community and enables other members to develop and iterate faster as well as creating a more consistent user experience.

From a design point of view, the common understanding of design systems may resonate deeper to the definition that it is the unification of three interconnected systems: resources, operations and products. This is also the approach that I have taken into developing my own work. A design system is a comprehensive set of correlated patterns and standard practices to accomplish the objective of a digital product. Patterns are reusable components that are put together to build interfaces such as icons, typography, colors, buttons and input fields. Practices are the methods we use to create, develop, iterate and communicate while working as a team (Kholmatova, 2017). Alternatively, another way to put it is to describe the design system as a shared visual language for the team, which helps to avoid miscommunication in order to build better, faster and create more scalable products (Saarinen, 2016).

As such, no standard definition exists for design systems. Depending on the style and value of the organization, the definition of the system will be different. The success of the system is determined by whether it is applicable to the team's workflow, and if it is capable of fulfilling user needs and solving problems.

2.2 Merits of a design system

Understanding the value of the design system can be critical to determine whether this approach is going to be helpful for an organization. The most commonly recognized benefits of design systems are listed below.

Scales design

A design system makes scaling digital products possible and helps to create alignment in teams. When a digital product grows, a coherent system of interconnected components allows it to scale digital products more easily. It closes the gap between each platform, devices, and screens; connecting each part of the product as a whole and making sure each UI component stays up to date (Suarez et al., 2017).

A design system also helps to grow the team by establishing alignment in the team structure and design principles. When the product development team expands, a design system supports new team members with onboarding quickly and to familiarise with internal operations once they have joined the team.

Strengthens collaboration

A design system provides a single source of truth for building interfaces by eliminating unnecessary effort spent on regularly checking design specifications for the same element (Baskanderi, 2018). It also helps to remove the friction in communication between the designer and developer. This way, designers can concentrate on the experience, while developers can focus on implementation.

In addition, design knowledge is no longer owned by a particular individual. All established tools and principles are transparent and easily accessible online. Making remote collaboration possible by removing the physical constraints of working in different locations. Furthermore, it empowers non-design professionals to create content and/or visual material easily in line with the brand (Skjoldbroder, 2018).

Controls design debt

While digital products grow and production teams continuously mature, all team members have their own individual goal to achieve, and personal deadlines to meet. This may lead to sloppy design being created, components misused or files corrupted. In addition, visual and technical debts will accumulate when design is created for short-term need and when functionalities are being implemented as a temporary fix (Suarez et al., 2017). Gradually this leads to maintaining a website becoming a struggle. A design system restrains the pattern of creating non-reusable components that cause inconsistent styles by ensuring that the system sustains itself when new alternations are made.

Improves consistency

A design system allows the design to be created consistently by using reusable components following standardized patterns, whereas spontaneous design often creates more confusion instead. Indeed, more consistent patterns help to create clarification. Standardized components also allow the designer to spend less time making a design decision for the same purpose and more time to develop a better user experience (Suarez et al., 2017). A design system supports the designer to anticipate interaction by learning through consistent guidelines.

Faster iteration

Faster iteration on components speeds up the prototyping process for each production cycle. Less time is spent on crafting pixels and more time is spend on user research and testing in order to improve the user experience. An established component library allows the building of a prototype to be as simple as putting building blocks together and assembling them into a functional model (Suarez et al., 2017). Updates made on visual components are directly in sync with the front-end code. This, in turn, eliminates time spent on quality assurance.

Enhances usability

Interface inconsistency harms usability. To be more precise, if interface components are customized coded and their interaction increase, then it will have a significant impact on page weight and slows down performance in terms of load speeds. This in turn often leads to bad user experience. creating unification in the source code library helps to prevent errors caused by conflicting CSS and javascript (Suarez et al., 2017). A design system helps to enhance usability by eliminating tasks such as manually testing and updating, and it ensures a holistic user experience not only on an individual page but for the entire website. Furthermore, it improves accessibility by optimizing components to fulfill requirements stemming from regulation.

2.3 Demerits of a design system

For someone who just started to explore design systems often find them more appealing than unappealing. This is often because of the current hype surrounding design systems or by companies that are marketing design systems as an attractive product without mentioning its potential drawbacks in order to make a sales pitch more promising. However, just as

every tool, a design system has its pros and cons. As designers, we need to be aware of these potential constraints and consider multiple views when considering to opt for this method. Common demerits of design systems are listed below.

Limiting choices

A design system prevents making customization and does not encourage the concept of creating various unique elements. A unified system means limited choices and standardized elements, that cannot be tailored for a specific purpose in order to be applied to a particular area of a website (Suarez et al., 2017). In other words, a design system may make it difficult to create an all-round experience as it makes tailoring design for specific needs more challenging. As such, designers can feel limited or restrained when making a design decision.

Constraining creativity

Design system can constrain designers who use interface design as a way to practice craftsmanship as there is a well-defined single source of truth. When a designer uses a design system, it is expected to follow the certain specific rules and therefore other possible solutions may be neglected. When the design process does not spark creativity, designers may feel less motivated to explore new styles (Skjoldbroder, 2018). In the long run, it might have a negative impact on the designer's professional growth and may prevent the user experience of a certain product from evolving.

Increasing system inflexibility

As a design system grows mature, the way of working becomes a pattern. A lot of the established rules and patterns will remain unchanged for years or even decades while still affecting the system. Without continuous management and frequent updates, the system may become inflexible over time (Skjoldbroder, 2018).

2.4 Foundations of a design system

A design system is composed of tangible and intangible elements. It consists of a collection of reusable components, guided by clear standards, that can be assembled to build a number of applications. A design language is defined for designers to communicate with each other efficiently. To be more precise, a design language describes the attributes of the

brand elements that can include color, typography, icons, illustration and spacing. These elements can be combined to build more complex user interfaces components. These components are then categorized by functionality and organized in a coherent structure based on its complexity. This in turn forms a pattern library. When designers use the pattern library to create user interferes, a set of reusable standards are followed to evaluate their work. These are also known as design principles and support teamwork towards achieving the same goal and vision. This chapter introduces and analyses the building blocks that support the design system as its foundation.

2.4.1 Visual design language

A design system enables a group of people to collaborate more easily and efficiently. In order to collaborate, it is essential for everyone to be on the same page and speak the same language. Indeed “Language is the method of human communication, either spoken or written, consisting of the use of words in a structured and conventional way” (Oxford Dictionaries, 1989)

Naturally, in order for a series of designs to be called a design language, the meaning of visual elements need to be clearly defined and organized structurally in order to convey ideas easily to its users. As such, any ambiguous or contradictory definitions can burden communication and cause confusion during the process.

If we break down a written and verbal language system, then it consists of words, punctuation, types of words, grouped words, sentences and paragraphs. We can see a structure of complexity and patterns, that are comparable to elements in a design language. A design language is the foundation of a pattern library. If we compare the components in a design language to a written/verbal language system then it would include the following elements described in this section.

Colors

The use of colors helps to create the ambient for the product interfaces. It should be either warm, enthusiastic, creative, playful and uplifting, calm, mysterious, intimate or personal. A color palette is created to best express a brand identity. When creating a color palette, it is crucial to check the color contrast. For instance, checking the color contrast of possible

combinations between the text color and background color ensures good readability. The variety of colors provides designers choices to create interfaces to meet a specific purpose. However, having too many choices can cause inconsistencies in brand identity and user experience. It is therefore recommended to start with a smaller set of colors and add more when deemed necessary (Kholmatova, 2017).

Typography

Typography includes the typeface, size, leading and more. The fonts choice largely determines the characteristic of a brand. The legibility of the chosen fonts has a significant impact on a product's usability. In most cases, a design system consists of no more than two typefaces unless it supports multiple brands (Suarez et al., 2017).

Type scale is the system of font size. When setting up a type scale, it is recommended to consider the eligibility of the selected typeface and its readability across devices. It needs to big enough to readable on smaller screens such as mobile devices, for instance. On the other hand, on larger screens, it can be scaled bigger to fill additional available space.

The text known as line-height in CSS can also help to increase readability by making more space between lines of text. The optimal text leading recommended by W3C is about 1.5 times of the font-size (Caldwell et al., 2008).

Spacing

Space is the most used key property in almost all user interface designs. Spacing properties include margins, paddings, positioning coordinates and border-spacing. No matter if the spacing is between logos, text, graphical elements, icons, product images or content, each whitespace should be well-thought-through in a design that is function-oriented and serving a specific purpose.

Spacings look most visually balanced when it has rhythm, which means using a unified number system based on patterns. Using a predictable spacing scale increases maintainability by creating a more consistent layout that is more likely to align and adapt well. A typical space system used in the design system is the 8dp grids system recommended by Google's Material Design guidelines (See figure 5) (Google Material Design, 2014). The reason for this is that an even number of pixels can prevent a half pixel offset when rendering

on a specific screen resolution. In addition, the majority of popular screen sizes are divisible by eight, which makes for a safe solution (Dahl, 2016).

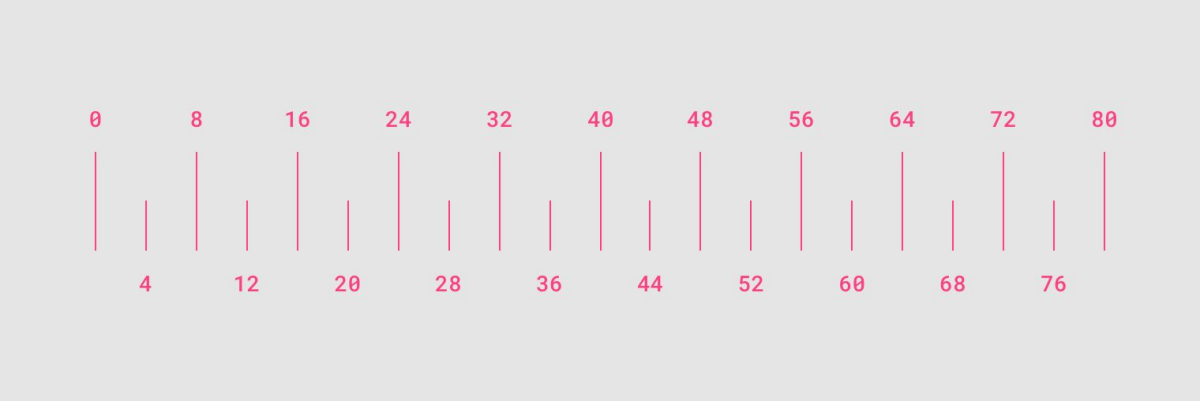

Figure 5. 8pd and 5pd unit based spacing system from Google Material Design guideline. Image from (Google Material Design, 2014).

Images

Images including icons and illustrations provide visual cues to the user in order to quickly grasp a concept, function or meaning. Images are a crucial part of the design language which should be documented with instructions, reasoning the design decision and define the meanings behind the color, shape, line, etc. Furthermore, images should include explicit instructions relating to their usage and team members should have easy access to these visual materials.

Based on specific needs, a design language can also include other standardized style properties such as visual forms (depth elevation, shadows, rounded corners, texture) motions, sounds and more.

2.4.2 Pattern library

A visual design language sets the tone for the general visual style and how things look on a broader visual spectrum, whereas a pattern library is also known as a component library or user interface library, looks at the actual components shown on the user interface.

Most of the pattern library is structured using an atomic design methodology; a methodology consisting of five levels of component cofunctions brought together to build design systems

more structurally and hierarchically (Frost, 2016). These five levels of atomic design are atoms, molecules, organisms, templates and pages.

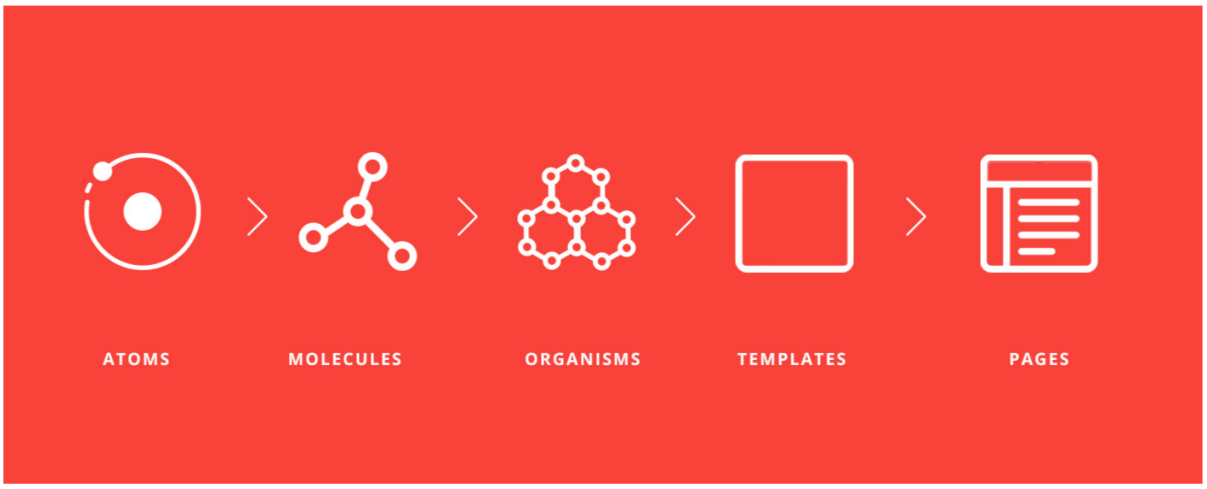

Figure 6. The atomic design methodology is using atoms, molecules, organisms, templates, and pages together to build functional interface design systems. Image from (Mudhar, 2018).

Atoms

Atoms are the smallest, most basic components such as buttons and icons. Each element has its specific meaning and it can not be destructed without changing its meaning (Frost, 2016).

Molecules

Molecules are combinations of two or more atoms connected by chemical bonds. In the context of user interfaces, molecules are assembled by two or more atoms that carry their own properties and form a more substantial and functional component such as a search form that consists of a form label, input and a button (Frost, 2016).

Figure 7. A search form molecule is composed of a label atom, input atom and button atom.

Organisms

Organisms include a wide range of complexity. Properties of organisms are an assembly of smaller components like atoms and molecules into a larger unit. They are a part of the interface such as a navigation bar or header (Frost, 2016).

Figure 8. A header organism includes a search form molecule, logo atom and primary navigation molecule.

Templates

A template is no longer part of the chemistry analogy but something closer to the final result of a webpage. Templates put comparably abstract properties like atoms, molecules, and organisms into context. Templates are useful to demonstrate how different pieces of units work and look like when they are grouped together on a webpage. The main focus is on the underlying page content structure instead of its final presentation (Suarez et al., 2017).

Figure 9. A homepage template that has organisms and molecules applied to its layout.

Page

A page is the refined version of a template that is filled in with real content and showcases the final visual presentation of the page. Besides showcasing the actual content, pages are essential indicators to test the legibility of molecules and organisms when they are

assembled (Frost, 2016). Inspecting the layout of a web page helps to determine if components are visually harmonious and functional. In case components do not work well together, then adjustments to lower levels components are often necessary.

2.4.3 Design principles

After assuring visual alignment, setting up general principles is a way to guide designers to work on the same goals. Design principles are shared standards for designers to evaluate their work. These principles define the properties of good design and guidelines on how to achieve it. Instead of receiving feedback based on personal opinions - which often is a biased view - introducing a set of universal values supports team members to work towards a common goal while working independently. It helps designers to answer questions like: Is this a good design decision? Are you working in the right direction to achieve the team's vision? Is this product ready to launch?

Depending on the organization, design principles can focus on a brand, team culture or design process. These principles cannot be compared and quantified. They can be used in a project to express a certain direction for a limited period to achieve particular goals. On the other hand, design principles can also be used for long term goals that reflect a company's long-lasting communal values. Depending on the size of an organization, each team might have their own specific set of principles or guidelines.

Although every company has a different approach to define design principles, there are some key principles to keep in mind when creating design principles. First, avoid general and ambiguous phrase like "simple" and "useful" instead use practical and actionable phrases such as "make it unbreakable" or "start with needs". Second, do not make a long list with principles but try to keep the list with principles as short and clear as possible. Finally, try to make design principles relatable and memorable by showing good and bad design examples (Kholmatova, 2017, p.49-56).

Regardless of the brand value, a design is made for the user. Creating a better experience for the user should be the core driver of design principles. It takes time to mature and refine design principles and this can be best achieved by continuously testing and improving through iterations.

2.4.4 System parameters

System parameters shape the characteristics of a design system. It defines how strict or loosely a design system should be followed, if the components built should be modular or integrated and the members to operate and maintain the system, for instance.

Finishing building a pattern library does not mean the completion of a design system. There are multiple factors that affect the qualities of a design system, which include the team format, company culture, the type of product being sold and design principles. In order to see how each factor influences the system, the following three main aspects are used to characterize a design system.

How strictly should a design system be followed?
A design system with strictly defined rules ensures that each design decision and its implementation is precise, predictable and consistent. It also ensures that the component and code library are better connected. However, the downside of a strictly defined system is that it tends to be rigid and inflexible. The designer may, therefore, have to trade off user experience for consistency (Kholmatova, 2017).

When a design system is loosely followed, it means that the system is flexible and provides more freedom to create a design that works well in a particular context. This type of design system encourages creative experimentation and explores different possibilities as long as it follows a general set of design principles. However, without a fully aligned team, duplicate files may appear and the system can become disorganized. Furthermore, it could lead to visible disintegration between different parts of a website and damage the performance and quality of the product (Hacq, 2018).

It might appear that the strictness of a design system is related to the size of an organization. However, it is not infeasible to develop a strict system within a small team, or for a large organization to operate a flexible system. In fact, the style of the team and its shared values could play a more significant factor in determining the strictness of design system than the team size.

The modular or integrated design system

In the context of design system, a modular design approach means that the system is built with interchangeable parts. Each part can be assembled together in various ways to meet multiple or varying user needs. A modular system is more adaptable, agile and easier to maintain. This modular approach is more applicable to a project that needs to evolve and suit various type of user needs. In addition, this is approach is also useful for projects for which the majority of components need to be reusable and where different teams are working at the same time. The industries where this approach is used are for instance e-commerce, finance, and governments (Hacq, 2018).

The counter approach of a modular design is an integrated design system. An integrated design system can also be made of parts, however, each part of the system is not designed to fit each other in various ways. Usually, the components of an integrated system are more connected, faster to develop, and can be tailored to suit specific purposes. It is suitable for the type of project that is created for a particular purpose; that is one which does not require change or scale; where the components are not to be reused and the design direction is distinctive from the general design principles. Suitable project types are campaigns, sub-brand, side projects or experimental projects.

Central or distributed organization

Whether a team has a central or distributed organized design system depends on who has the power and responsibility to build and maintain the system. A centralized model means there is usually one person or one group who is in charge of managing the system. They are the personnel that specifically work on the design system by creating a pattern library and setting the design principles (Kholmatova, 2017).

On the opposite side, a distributed organized system means everyone in the team has the right to influence the design system. It enables everyone to be part of the process while shaping the form of the design system. The decisive factor for this is likely to be linked to the size of the organization. However, the size of an organization is not the primary factor that determines the system's organization style. The next sub-chapter elaborates on how design systems can be managed by different team models and compare their advantages and disadvantages.

2.4.5 Team model

A digital product is built for end users and a design system is a tool created for the creators of the digital product to create better designs. The operation style of a design system affects the system characteristic and influence the internal workflow. Nathan Curtis (Curtis, 2015) identified the following three common team models that are used by organizations to manage design systems.

The solitary model

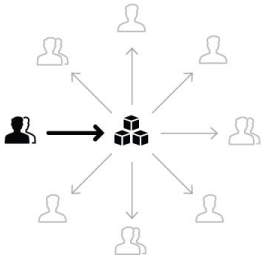

Figure 10. The solitary team model meaning the design system is managed by one person, also known as the "overlord" model. Image from (Curtis, 2015).

Also known as the "overlord" model, is a model in which one person is in charge of the design system. The solitary model is often quick and disorganized which can generally work well if the system is created for an existing team. For a growing team, where multiple teams are to adopt a system managed based on one person's value, opinion, and principles, this approach can potentially be a barrier for the product to grow.

The centralized model

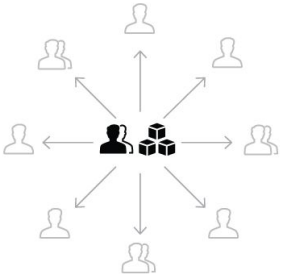

Figure 11. Design system operates on the centralized model is managed by a dedicated design system specialist team. Image from (Curtis, 2015).

On the other hand, a design system with a centralized model is one in which a dedicated group of people is responsible for curating and maintaining the system. This model is often used by a design-oriented company like Airbnb and Apple, for instance (Anne, 2015). The team creates a pattern library and keeps the design system well-maintained but they do not necessarily involve the actual design of the product. It protects the team from a biased view resulting from overweighting demands and inconsistent creative direction. However, a design system with a centralized model could lead to a lack of awareness regarding the end user's needs and overlooking the design team's everyday challenges.

The federated model

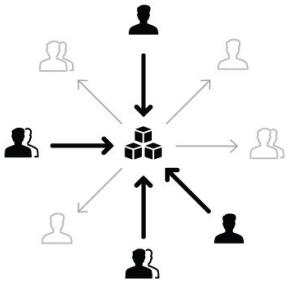

Figure 12. The federated team model allows everyone who works with design system to edit and update the system. Image from (Curtis, 2015).

A design system operated in the federated model is one in which every member contributes to the system. Everyone in the team has the right and responsibility to work on the system, which allows the system to build upon the actual needs that are reflected by its end users

and the production team. This means that the system is capable of serving the right purpose. However, a potential drawback is that without having certain members of the team being in charge to maintain and further improve the system, attention may shift to other tasks, which could stop the system from evolving over time.

The team model can change over time along with the growth of the organization. The most suitable team model is one that properly aligns with the priorities of the team and the company culture. A fitting team model ensures the development of the design system runs smoothly. A design system is a valuable tool that many companies use to promote their way of working, to communicate the company values to the general public and potentially attract like-minded talents to join the company. A well-operated design system also helps the company to sell the system to the internal team. Only when a design system's operation style can easily be adopted by each team member, it will be taken into practice by the majority of the team. Indeed, a tool is only useful when it is utilized by people.

2.5 Benchmarks

This chapter compares design systems used by a larger e-commerce company namely, Shopify against a smaller e-commerce company namely, OpenTable. The objective of this chapter is to gain insights in how the approach of the companies towards design systems differs by taking into account the size of the organization, the structure of the team, the design system operation, and the role of design systems in the product development process.

Shopify has been chosen as one of the benchmarking companies due to the following reasons. First, Shopify is one of the leading providers within the e-commerce platform industry. Second, Shopify's platform is one of the service platforms that is currently being used by my team for developing web shops and thirdly the company is a large organization, and therefore suitable for the purpose of this benchmarking analysis.

The other company, OpenTable, is a medium-sized company that provides services to both sellers and customer user groups. Their approach to developing a design system places more focus on expressing the brand identity versus the actual component library, which is

very different from the Shopify's approach. For these reasons, OpenTable has been chosen as the other benchmarking company.

2.5.1 Shopify

Shopify is an e-commerce platform provider for online-retailers and point-of-sale systems. The platform offers an integrated system of payment, marketing, shipping and customer engagement tools to simplify the process for merchants to operate an online store.

Company Size

By August 2017, the company had around 3,000 employees and their platform has been used by more than 600,000 merchants worldwide.

Introducing the Polaris Design System

In 2017, Shopify launched the Polaris design system that is representing the North Star to guide Shopify's design principles. The design system is not only built for internal use by Shopify product development team members but also for the Shopify's partners who work with this platform.

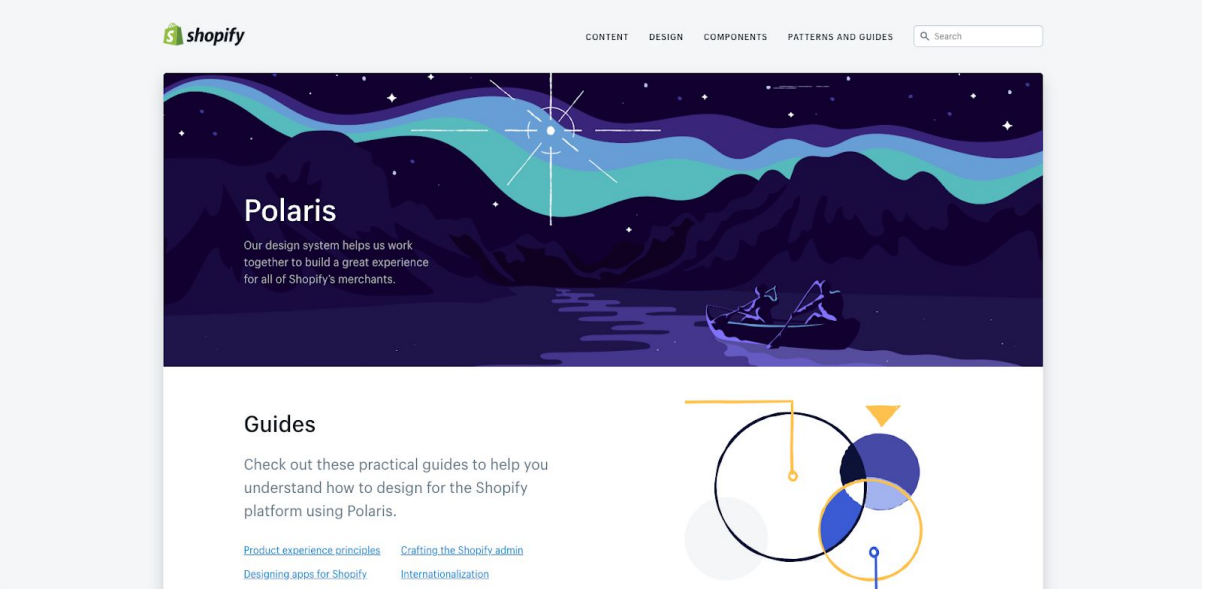

Figure 13. Polaris Design system developed by Shopify (Shopify, 2017).

2.5.2 OpenTable

OpenTable is an online restaurant reservation service company founded in 1999 in San Francisco. Besides providing a reservation service for diners, OpenTable provides restaurants with reservation management software. Their services are provided for two user groups: diners who look for a restaurant to eat and reserve a table, and restaurant owners and managers, who take reservations, process requests from the diners, interact with customers and take care of other practicalities (Aldrich, 2015).

The size of the company

The size of the company reached approximately 1450 employees in 2019. Furthermore, OpenTable serves over 32,000 restaurants globally and has helped more than 17 million diners making reservations through online bookings each month (Aldrich, 2015).

Introducing the OpenTable Design System

In 2015, OpenTable launched a new brand identity site. The brand identity site has similar attributes and structure as a design system as it includes general brand values, and guidelines for the usage of the logo, color, typography, photography, illustration, iconography, and design principles. These design components are made available to download from the brand identity site.

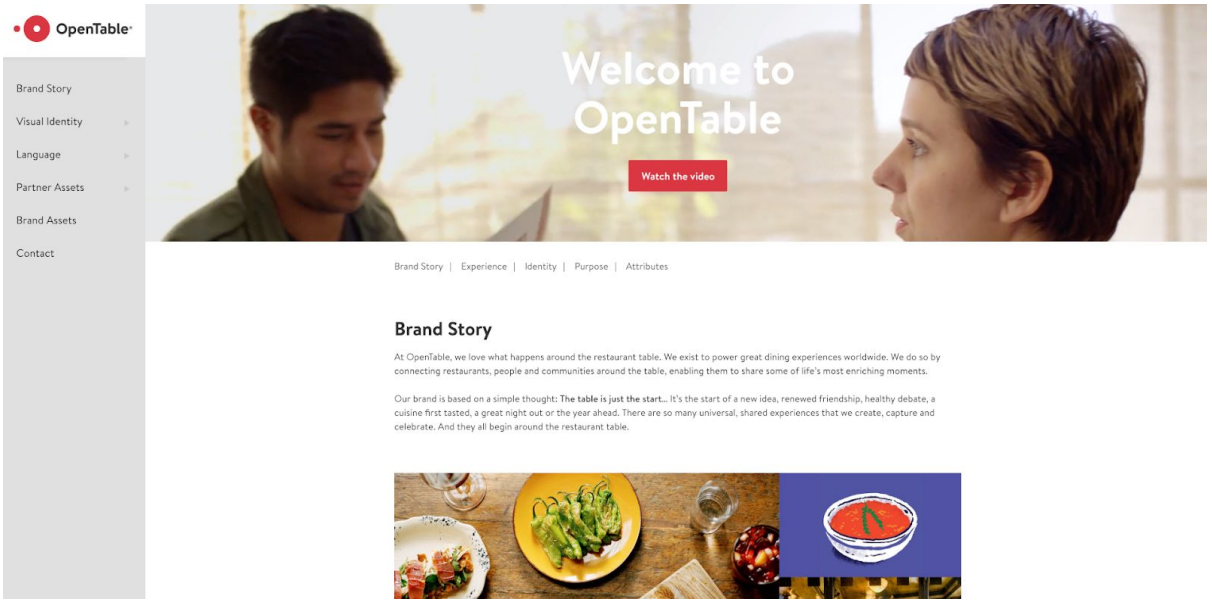

Figure 14. OpenTable brand identity site (OpenTable, 2017).

2.5.3 Comparison

Team Size

The Polaris design system has been built by 225 UX designers from different teams, and it took approximately three months to complete the first version of the system. The roles of team members consist of senior UX leads and principle designers to the VP of UX design (Fanguy, 2018).

Although OpenTable, which was founded in 1999, has been one of the oldest companies in the San Francisco area, design has not been key focus area of the company until it joined forces with Foodspotting in 2013 (OpenTable, 2013); and when the designer founder of Foodspotting, Alexa Andrzejewski, started to build OpenTable's first in-house design team (Koschei, 2016). The design team members grew from 0 to a multidisciplinary team of 28 designers by 2016 (Aldrich, 2015). The design roles include product designers, user researchers, brand designers, marketing designers and a UI writer (Aldrich, 2015). The product design team is divided into two groups focusing on diners and restaurants user groups.

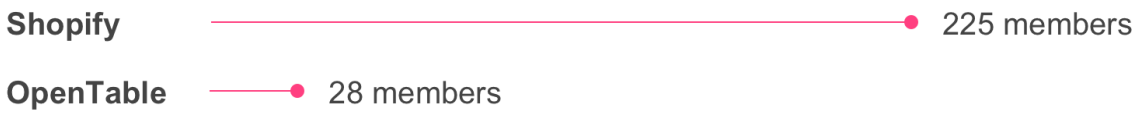

Figure 15. The size comparison of the design system development team between Shopify and OpenTable.

Team Model

Shopify has employed several different team models throughout the company's growth. Most recently, they have moved to a federated team model by removing two designers and six developers who were in charge of the old design system and distributing the responsibility to UX designers across several teams. This decentralized organizational model removed specific ownership and allows the entire UX team to contribute to the design system. While the team leads reviews the output, the entire UX team has been able to identify correlations

between patterns and maintain the constancy of the system. As a result, the quality of their projects has improved (Peatt, 2018).

The designers of OpenTable similarly operate in a federated model. Usually, designers work alongside their respective teams: product design, user research, brand design and the marketing team. They collaborate during certain scheduled team activities such as weekly team share-outs, design drinks, lunch discussions or team syncs (Koschei, 2016). Everyone works together as partners, which encourages to be open and share each other work as there is not only one person in charge (Aldrich, 2015).

Figure 16. OpenTable designers from different teams collaborating during a design meetup. Image from (Koschei, 2016).

Pattern Library

Shopify's Polaris is a powerful design system, which contains an abundance of design and development resources. The component library is well-organized and detailed-documented. Its visual design language resources include color, typography, illustrations, sounds, icons. Interaction states, spacing and data visualizations. Each category specifies the guidelines, attributes, do and don'ts, accessibility requirements, UI kit and code files.

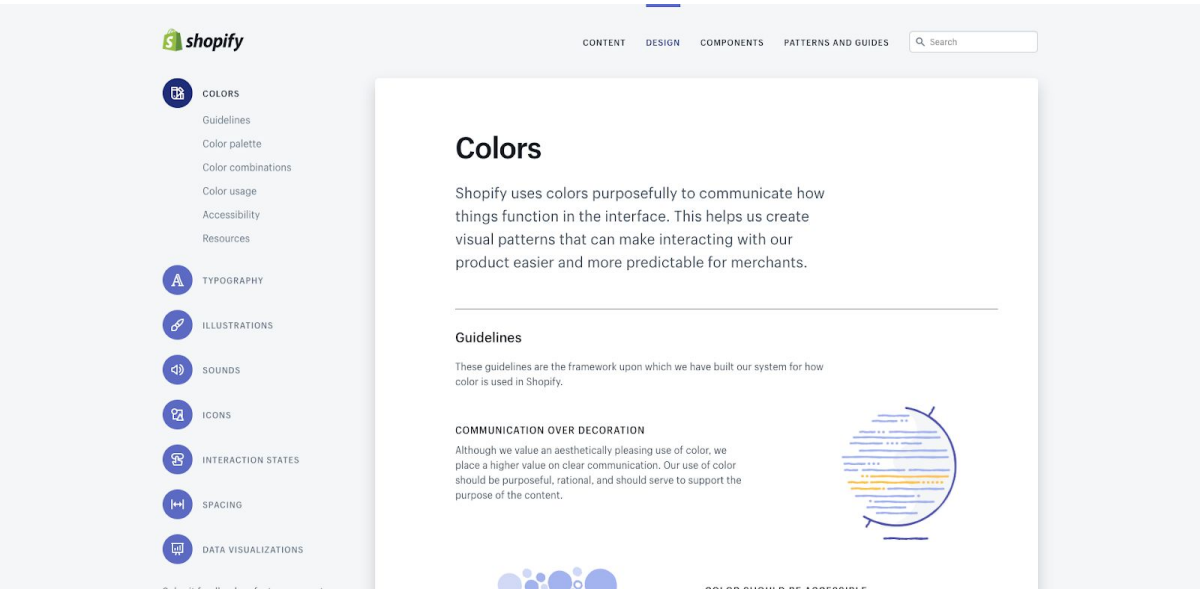

Figure 17. Shopify Polaris design language (Shopify, 2017).

The Polaris' pattern library provides a unique feature called ''component status'' where it shows a clear view of all the components that are in a different stage of the development process. Each component listed shows its current status, which can either be: design-in-progress, under-development, under-consideration, not currently planned or component has been released in one of the versions. The users of the system can receive clear information about the recently published or upcoming components.

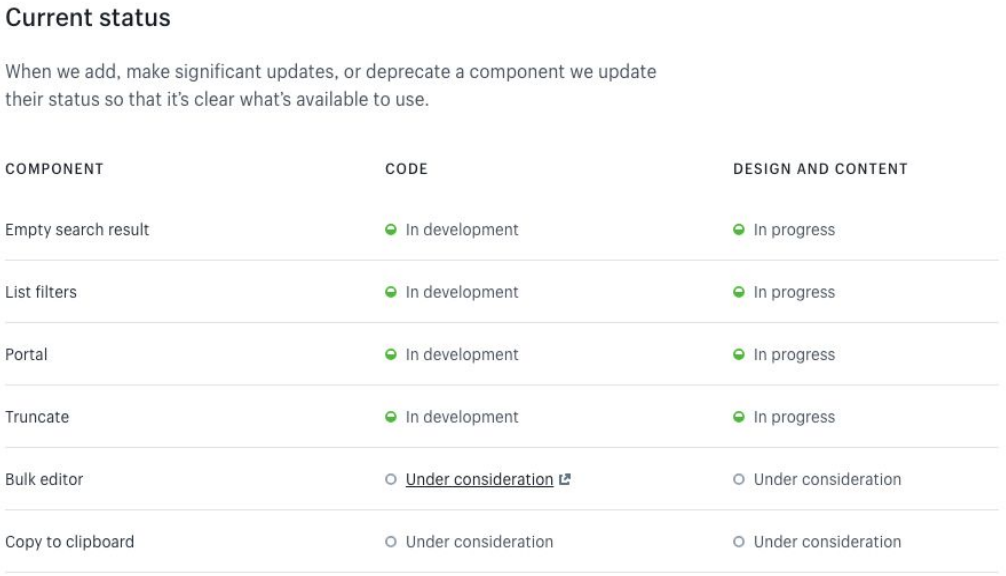

Figure 18. Polaris's component status keeps the user informed about the development process of individual components and provides system transparency (Shopify, 2017).

The standard component library contains UI resources and guidelines, which includes best practices, examples, content guidelines, related components and more. The guidelines are specific, structured and with great details, instead of using conventional atomic design methods to structure the pattern library. Shopify's Polaris categorizes components according to the team's mental models as the design system provides resources to support the work of multi-disciplinary users, including designers, developers, and content strategists. Furthermore, it is challenging to find a way to structure a component library that takes into account different mindsets coming from different disciplinary groups. However, the system is continuously changing according to the outcome of continues internal user testing, user research, and usability studies (Fanguy, 2018).

The design system OpenTable, on the other hand, is rather simple and organic. The design language contains the logo, color, typography, photography, illustration, and iconography. Each category group provides documentation of the guidelines, examples, attributes, do's and don'ts and several downloadable assets.

The OpenTable design system has put more focus on elaborating their brand identity and guidelines for creating content. The site provides a basic level of design resources. To be more precise, besides defining the fundamental design elements, the OpenTable design system does not provide more complex components or patterns that would form a pattern library.

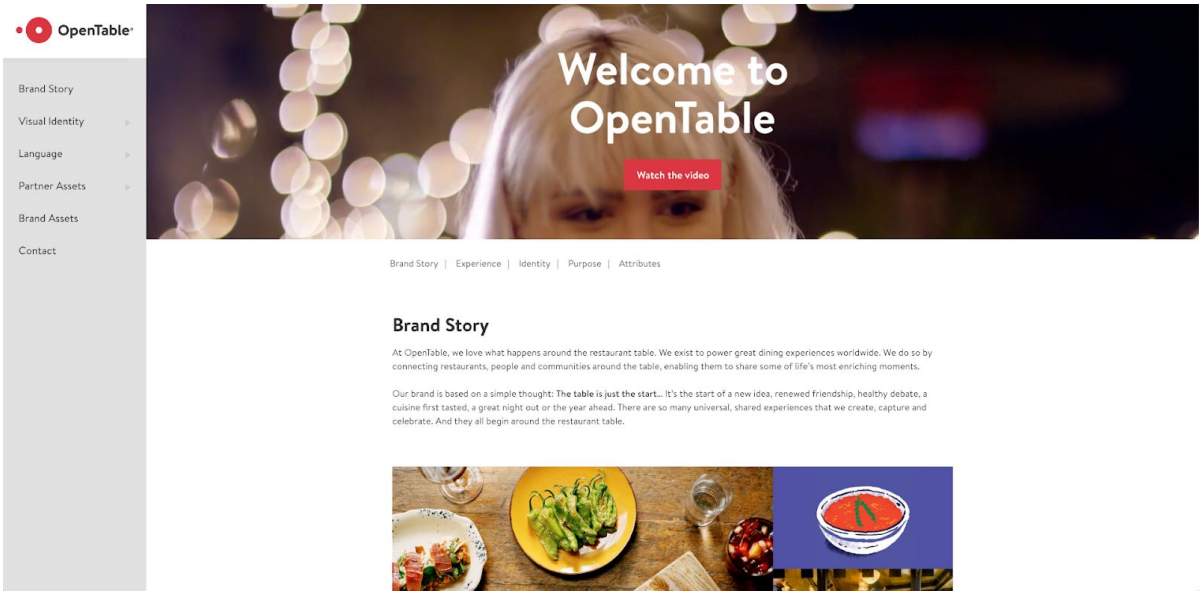

Figure 19. OpenTable design system is rather simple and organic.

Design principles and system parameters

In Shopify Polaris, design principles are defined specifically under each component category. As such, designers follow a different set of principles that are specified in detail for a given type of component when designing certain areas of an interface.

Polaris enables people to build experiences that look and feel like it has been designed by the same team (Couto, 2017). The rules of the system are defined relatively strict in order for the modular-designed components in the library to be used in various ways and to suit different purposes while staying consistent with work from others.

In comparison, the design principles in the OpenTable system employs broader guidelines such as: warm & welcoming, inspired & reliable, fresh & current and adventurous. The system does not set strict rules for each specific group of components as long as the designs are leaning towards the same goals, and the voices are expressed in the same tone.

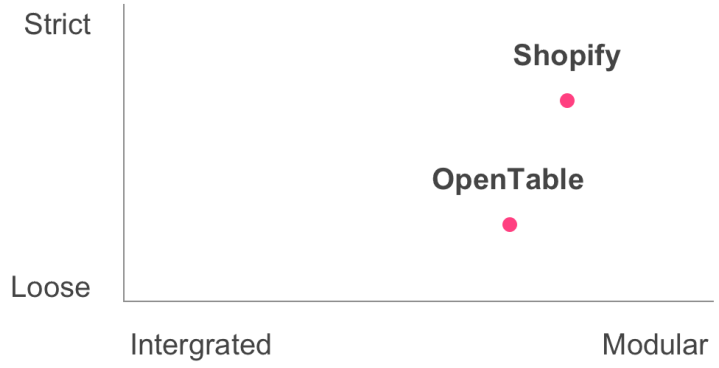

Figure 20. Comparison of design principles and system parameters between two systems.

Summary

Based on the data collected from each design system, the results indicate that team size does not have a direct relation to the team model that is used to operate a design system nor does it impact how integrated or modular the components are built. However, the company size and team size do seem to have an impact on the size of the design system and its complexity. Building a design system within a larger organization often means that the design team can provide more time and resources working on the system in order to supply higher demands internally and externally. However, their design system needs to be built complex enough to be capable to meet the demands of large scale production. A larger company

operates based on more extensive production teams, and the technical requirements often require higher system complexity.

In addition, a design system of a larger company also seems to require more precise and restrictive rules to define how each type of components should be used in different cases. This is necessary since it is almost impossible to maintain consistency in work produced by a few hundred employees without setting clear rules and principles to guide every user while working on individual projects.

A design system is an investment made by companies to help users close the gap between each other's work. However, with different company sizes, a team need to use different approaches to optimize their design system in terms of how the system operates. For a larger company, the design system needs to be documented more specifically to overcome the communication gap. This is not necessarily needed for a smaller company as it easier for a small team to communicate and share work among team members in order to make design decisions. Furthermore, a design system for a large company tends to require more complexity in order to supply greater demand from production needs.

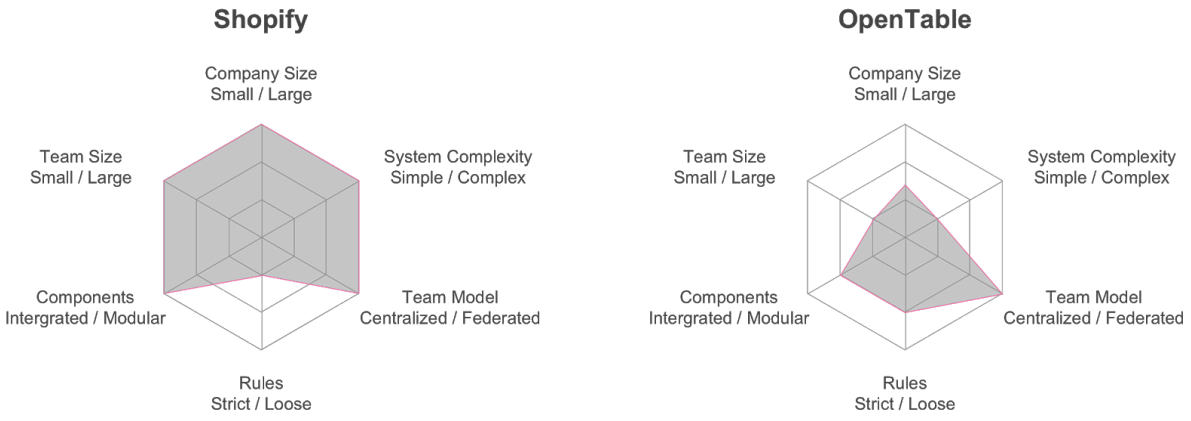

Figure 21. Design system attribute comparison between Shopify and OpenTable.

3. Methodology

A design system is known to streamline complex production processes and help maintain consistency of work in a larger organization. Many large companies such as Apple, Google and IBM have adopted design system as their design production frameworks. Studies on

whether design system is also useful to be employed by smaller companies are however limited and as a designer who is working in a smaller organization, I have noticed that there is a research gap in the usability of design system for smaller teams.

The objective of this research is to provide knowledge to support designers that are working with a design system and/or work in the e-commerce field. The findings of this research provide insights on how a design system works for a smaller organization and provides recommendations on how to build a design system that can be used by smaller teams?.

This research uses qualitative data and systematic observations in order to develop an in-depth understanding of the design system in different use cases. The qualitative data has been collected through multiple sources including conducted literature reviews, benchmarking analyses and a case study.

In the theoretical background chapter, information about the essence of the design system and its common practices have been discussed. Subsequently, a benchmarking analysis has been performed on two design systems that are developed by different size e-commerce companies namely, Shopify Polaris and OpenTable design system. The data collected includes company size, team sizes, team model, design system complexity and system parameters. By comparing the collected data, correlations can be observed between team size and the design system structure and the method of operation. The collected information from the theoretical background and data gathered from the benchmark analysis have been grouped to create themes that will be used to analyze and evaluate the outcome of the case study and support its findings.

There are related factors that might potentially affect the quality of this study. First of all, the design system is a relatively new term, and as a result, extensive academic research conducted on this topic is currently not available in order to support this study. Most of the data has been collected through secondary data such as design system websites, interview transcripts, e-books, online articles and blog posts. However, as the concept of a modular-design and its theoretical framework is also applied in other fields such as architecture, urban landscape design and industrial design, it has supported this research in defining the design system concept for this study.

Another factor that may have an impact on the quality of this study is that I have no previous practical experience in developing a design system for a large company and team to make comparisons. This could potentially lead to a biased view with respect to the case study findings and have an impact on the credibility of this study. In order to evaluate the project outcome objectively, supporting data has been gathered through benchmarking two design systems that have been developed by other medium and larger sized companies. This has helped to compare data across two case studies while evaluating my own project.

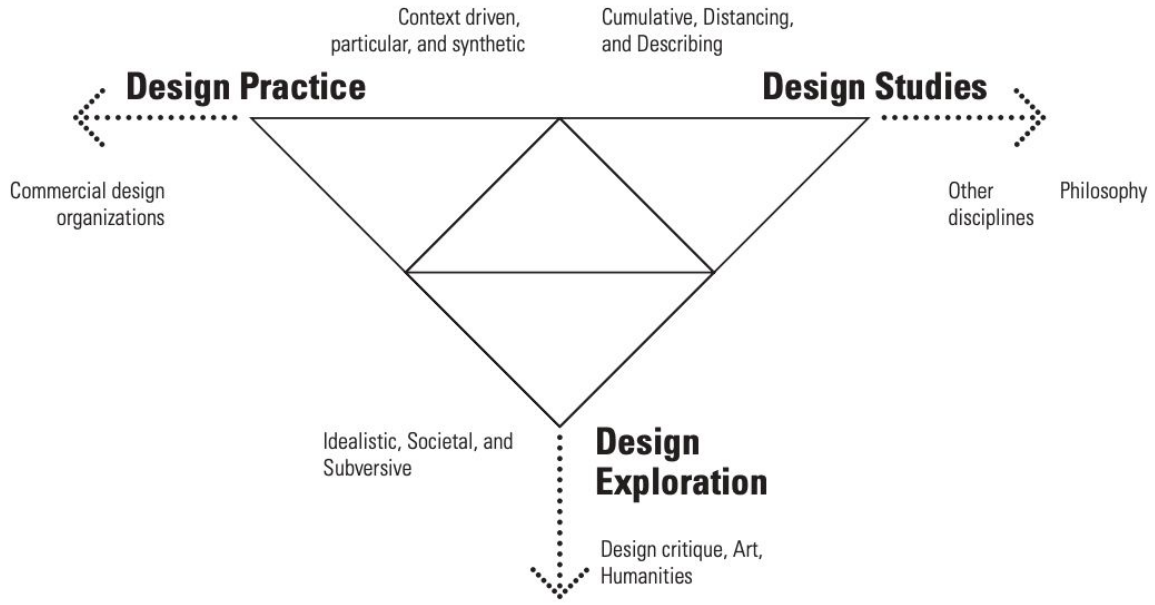

Figure 22. The research framework of this study is inspired by The Interaction Design Research Triangle of Design Practice, Design Studies, and Design Exploration. Image from (Fallman, 2008).

4. Developing a design system for an e-commerce website: A Case Study

In this chapter, the creation process of the Oxygen design system is documented in light of the previously discussed aspects of design systems. The design system is presented as the central production outcome of this Master's thesis. The Oxygen design system is developed as a tool to support the design process for a Finnish e-commerce site and consists of the core design elements that are essential for the production of the site.

4.1 Motivation

The motivation to conduct this study is based on a current opportunity to develop a large e-commerce website. The overall objective of the project is to build a new e-commerce website that drives sales in the EU with the main focus on four countries. The team working on this project includes a designer (myself), a front-end developer, a back-end developer, a project manager and a team lead. The small size of our team enables us to work very closely together and iterate rapidly. Nevertheless, being the only designer responsible for creating the entire website from scratch remains a challenging task. For this reason, I developed a design system to work more efficiently and structured in order to sustain a high quality of work.

For this project, the team works closely together with various stakeholders including a platform provider and the web and marketing team from the e-commerce company (i.e. the client). The ultimate project goal is to - upon its completion - hand over the website to the client and pass on any knowledge deemed useful to ensure it can be maintained in a sustainable way.

I attended several design conferences over the past two years where I learned about using design systems as a collaborative tool. At the conferences, many large corporations shared their methods of developing a design system and how to incorporate the system into the product development process. Furthermore, these companies emphasized that establishing a component library and design language made a positive impact on their product result. This made me aware that design systems are a powerful tool when it comes to creating consistency and high standard of works within large teams.

The benefits of design systems to help increase productivity sounds very appealing. However, to build and operate a design system is a big investment that requires a significant amount of time and resources. It is a cost-effective investment for large organizations with sizeable design teams that can provide sufficient resources. However, smaller teams - like our own - often do not have this luxury.

To get the most out of a design system requires investing a reasonable amount of time and resources, therefore it became necessary to understand and investigate - from a designer's point of view - the requirements to build a design system that is useful to be employed by a smaller team. As Alex Schleifer said, you cannot innovate products without first innovating the way you build them (Schleifer, 2016). This research, therefore, provides findings and recommendations that will be of great help for designers and developers who are working on similar projects to achieve their goal.

4.2 Initial concept planning

A larger project is more manageable when it is divided into smaller tasks. For this reason, we held a workshop at the start of the project to consider who needs to be involved in the creation of the design system. We identified the following stakeholders to be involved in the process of developing a visual design language and component library: 1) the designer, 2) a front-end developer, 3) a project manager and 4) the team lead. The objective is to build a visual design language and component library. The UI/UX designer (i.e. myself) is in charge of developing the visual design language and UI component library, whereas the front-end developer will create a corresponding component code library.

The team model used to manage the design system is a hybrid centralized model where the operations of the design and the code of the component code library are separated. The UI/UX designer is responsible for managing and updating all the design elements in the design system and the front-end developer is in charge of developing and maintaining the code in the component code library. In addition, the project manager helps to gather the client's requirements and ensures the product outcome fulfills their needs.

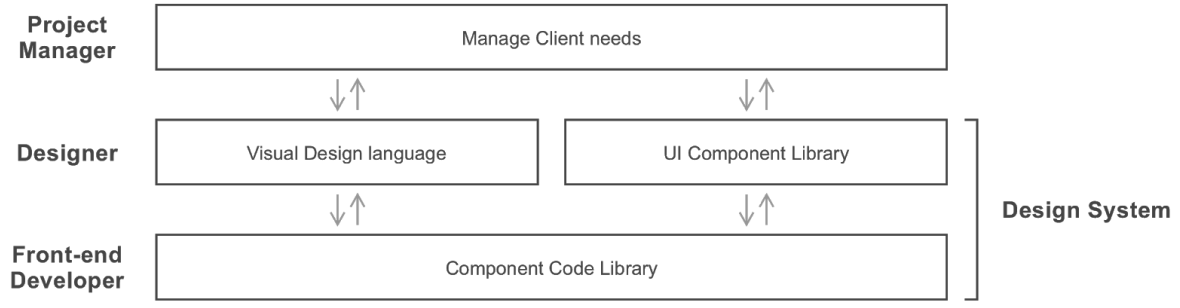

Figure 23. Roles and team model for operating the Oxygen design system.

To structure the design system, the team decided to use four levels of components namely bases, components, modules and pages as opposed to using an Atomic Design structure with atoms, molecules, organisms, templates and pages. The rationale for this is to create a simple structure that is manageable by 1-2 person and opting for a too detailed division of components would be unnecessary. The naming of the components was kept straightforward to make the design structure easy to understand for other stakeholders that may be unfamiliar with the component terminology used in the Atomic Design structure.

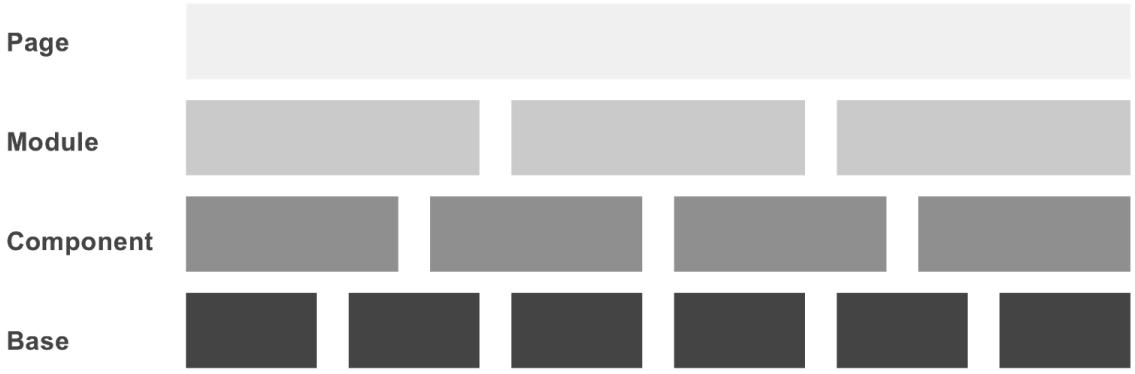

Figure 24. The Oxygen design system structure.

The approach used to name the UI component is to line up a string of different attributes that describe each component and separate them with a backslash. The attributes include screen size / level in the structure / component name / style variable / and state variable. For example, the button as shown in figure 25 can be found in the component library via Desktop / Component / Button / Primary / Disabled. The naming system for the front-end component library is not the same, however, but it does follow the same general logic.

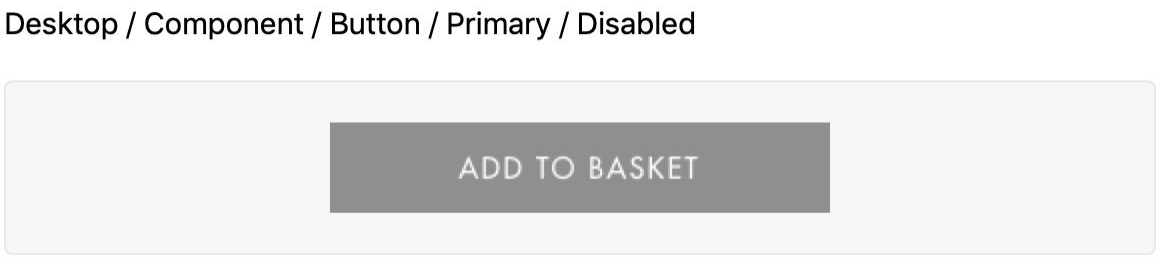

Figure 25. An example of how the naming system works for UI components.

Before starting to create components, the team also investigated various tools to manage the design system. The requirements for smaller teams to use such tools are much less sophisticated compared to large organizations that use these tools to manage more complex design systems. To be more precise, these tools should support smaller teams with simplifying and automating steps to create UI components, adding them to the design system and to modify the components as much as possible.

Larger companies with relatively complex design systems will often create their own design system management tools that are powerful enough to meet the demands of larger teams. For a smaller team, opting for a ready-made management tool is the most cost-effective option.

Various tools have been developed for the purpose of managing design systems. After researching these tools, the following three tools made it to the shortlist: Invision Design System Manager, Lingo and Lucid. The criteria for choosing suitable tools largely depends on the compatibility with tools that are currently used in the day to day work of the product development team. In addition, considerations of functionalities that are needed for handling the component library should be taken into account when choosing a design system management tool.

Invision is a tool that the team uses on a daily basis to create the prototypes and as it also provides a design systems management feature it was chosen as the most suitable tool to integrate into the daily workflow of the team. Invision Design System Manager uses the same sketch plugin for uploading prototypes and uploading UI components to the design system and therefore is well suited for the team.

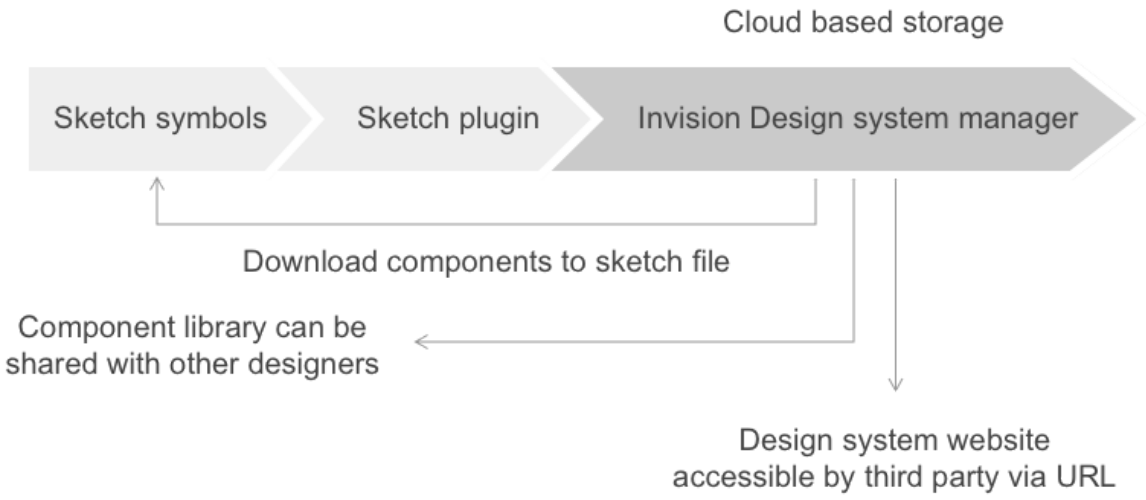

Figure 26. The design system workflow of Oxygen.

4.3 Shaping the core, building the design system foundation

The following steps to create a design system corresponds to the previously discussed design system aspects described in chapter two. The development process also documents the related skills and principles that are used when building the design system.

As discussed in chapter two, there are multiple aspects to consider when building a design system. In the e-commerce field, companies that have developed their own design system and made them public usually are larger companies (see chapter 2.5). The goal of this project is not to replicate design systems that are built by other companies but to learn from their experience and then create a design system that is sustainable, valuable and manageable for a smaller team.

After making a plan for implementing the design system, I started to work on building the design system alongside designing for the website. The starting point of building the design system is a simple guide provided by the client, which included two typefaces and three brand colors. Even though the guidelines are simple, they act as an essential foundation to build upon the design system.

The actual design of the site started from the home page, which is the page that contains the most information and uses the most variety of content and modules. Building the design system while designing the site had taken a significant amount of time. Designing the home page of the site would typically take one or two weeks. However, for this project, it took a much longer time since I had to create design not only for its functionality and style but also keeping the modularity of each component in mind. Indeed, the components needed to be reusable and in harmony with the general visual style.

Visual design language

Shaping the visual design language is a fundamental part of the system. It sets the tone to develop the quality of the other component elements further. The base colors of the brand consist of white, black and utility greys. The color options are purposefully limited to a minimum amount to prevent too many color choices that could lead to inconsistency in the brand identity. The design principles of the Oxygen design system - which are described later in this chapter - are significant factors that affect the color choices of the design system. One of the design principles, “Clarity and simplicity” encourages to remove decorative elements and distraction in the design in order to ensure that the content and the product itself are the main focus. Therefore, the color palette does not contain any primary colors. Pure black and white color choices also ensure good color contrast and readability in each combination.

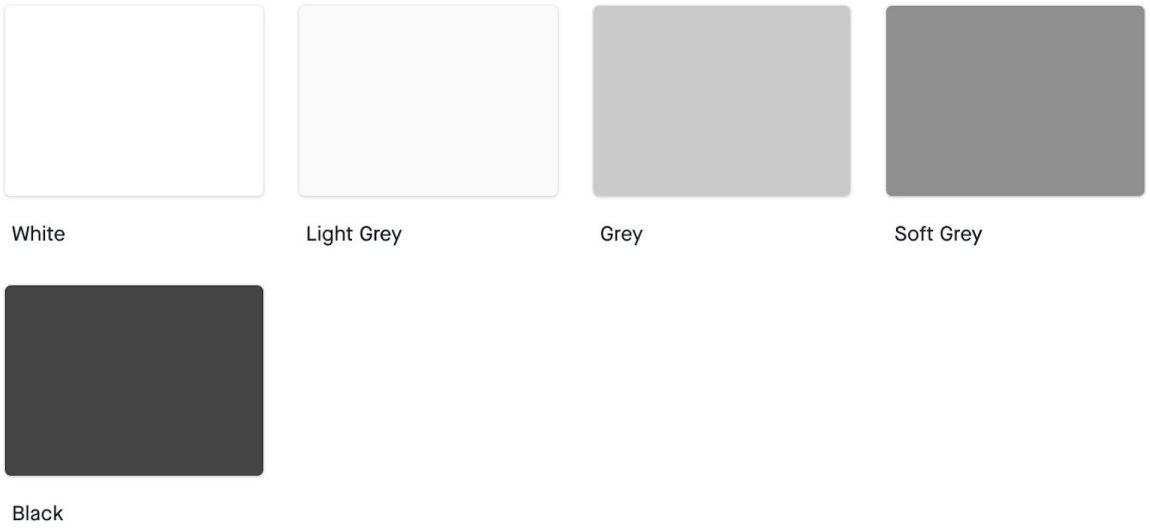

Figure 27. The simple color palette of the Oxygen design system.

The client provided two typefaces at the beginning of this project, namely a sans and serif font. The serif font is used for headlines and title text and the sans font is used for lift text, label and body copy. When setting up the typography system, it was divided into the following two groups: desktop and mobile. Each group contains the same text styles. However, the same text style in each group has a different type scale. The type scale determines the font size, text leading, and line height. The type scales are optimized to be displayed on desktop screens and mobile screens to ensure good readability across devices. One feature that Invision DSM (Design System Manager in short) has for managing typography is slightly problematic. Invision DSM treats same text styles in different colors or alignments as separate text styles. They are still the same text styles however differ in variation. Therefore, when using DSM to manage the typography system, one text style has to be duplicated into three separate styles when they each have left-alignment, center-alignment and right-alignment, for instance. Since the goal is to keep the design system very clean and neat, this feature appears to be inconvenient. Furthermore, it increases the time to spend to change one text style. Instead of updating the entire document, it requires to manually update all three duplicates that are in different colors and alignment. In addition, a simple set of typography system that has five text styles for each screen sizes is now multiplied three times into fifteen text styles. However, this feature might be useful if the design system has more complexity and each text style needs to be used very precisely.

Figure 28. Invision Design System Manager treats any text style variation as separate text styles.

The spacing system is established across the design and front-end library. For this project, it was agreed to use 5px unit based spacing system to handle spacing for the website. It appeared however that a 5px unit based spacing is not very useful for components that have tiny gaps between each other. For small UI elements that need to be precisely placed, 5px is still too big of a gap. For larger components and modules a 5px spacing unit works reasonably well, however.

The image system consists of the icons, logos, avatars and badges. Instead of storing all the image components in one sketch file, they can be retrieved easily from the design system. One of the advantages of storing iconographies in a design system is the ability to make them available for multi-disciplinary teams via a public URL to the design system site. For instance, our client's marketing team can access and download all the image components to reuse as brand materials for other purposes. The ability to share components is a significant advantage of a design system compared to passing them around through a sketch or photoshop document.

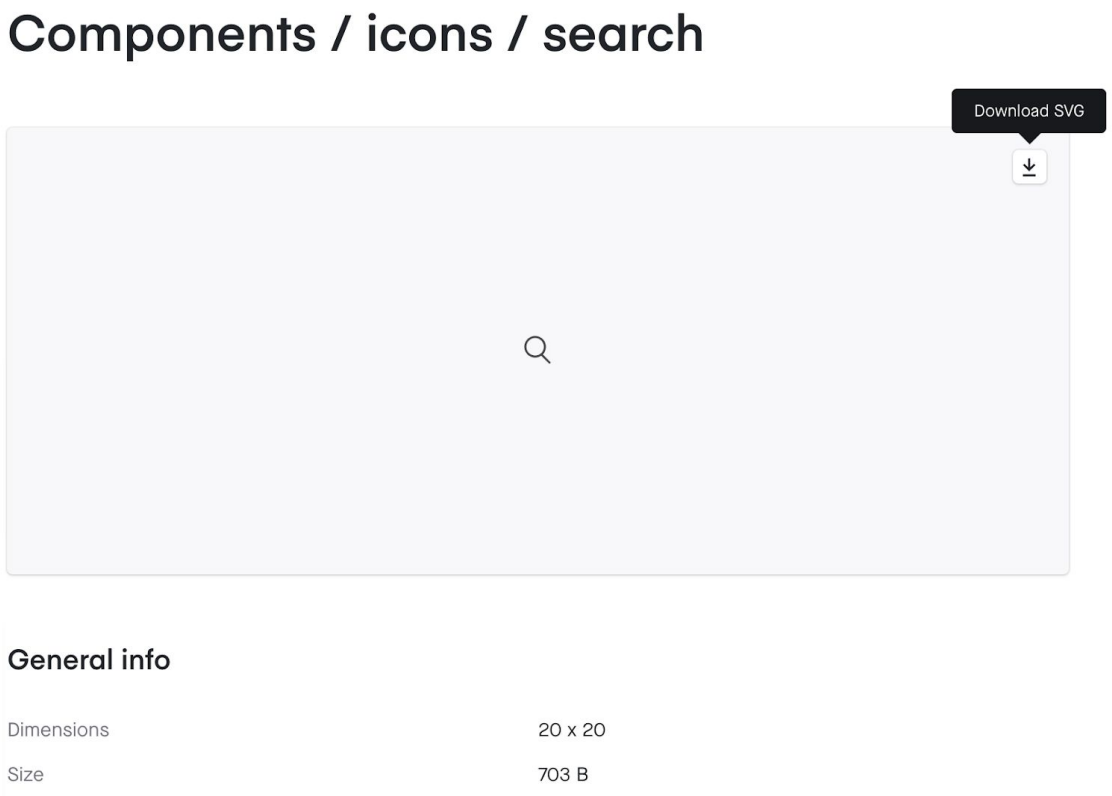

Figure 29. Every UI components in the design system can be downloaded and this allows multi-disciplinary teams to have easy access to the current brand materials.

Pattern library

The next step is to create components that are made by a combination of a few base elements. The product card is one of the most used components on the website. First of all, the product card in standard view is a combination of a product image, body copy and labels. After creating the standard product card in a normal state, variables of the card such as its hover state and sold out state needs to be created. Subsequently, each of the layout states is made into two versions to make it suited for desktop and mobile screens. This completes the process of creating a UI component set with variables (See Figure 30).

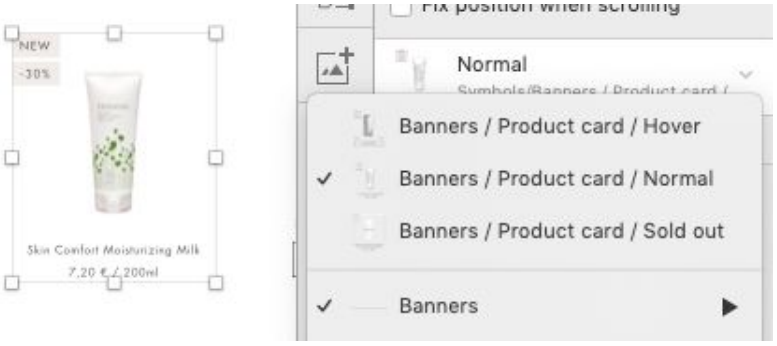

Figure 30. How a design system manager handles the UI component and its variables in Sketch.

The most important modules in the design system are the header and footer modules since they are used in the design of every single page. Creating the header and footer modules in the design system has significantly speed up the process of updating the styling of the header and footer. When changes are made on these modules, all pages are automatically updated. The design system enables the possibility to update the layout of multiple pages in the following two steps: first, change the header or footer module in the design system and then sync each module with the master component. This has reduced the amount of time spent on manually copy pasting the new module layout on all respective pages.

Starting the design of the site from the home page was a slow but useful process as it helped to build the main structure of the Oxygen design system. Once the homepage design was completed, the design system contained a mix of a variety of components. The established design system foundation enabled the design process to become smoother, more structural

and faster over time. The design system development process using Sketch and Invision's Design System Manager plug-in worked very well within the existing day-to-day workflow. For a one-person design team, it is manageable and does not add too much burden on the workload.

Design Principles

A few design principles are established to act as guidelines for design decision making. It includes design principles that are specific to this project, as well as the voice and tones of the brand.

The first design principle is "clarity and simplicity". When designing the product visual presentation, it is recommended to avoid unnecessary decorative elements to minimize distractions. Clarity is created by simplifying the steps for completing tasks and by putting the focus on the content and messages that the brand wishes to express, in order to guide the user to have their attention on the product itself. The second design principle is "universal". As the site is available in multiple countries as well as languages, the design needs to be made universally applicable.

The voice and tone of the brand are friendly and soft. The customer should always feel welcomed, taken care of and valued. The tone of the brand should be coming from a gentle voice that is helpful and trustworthy.

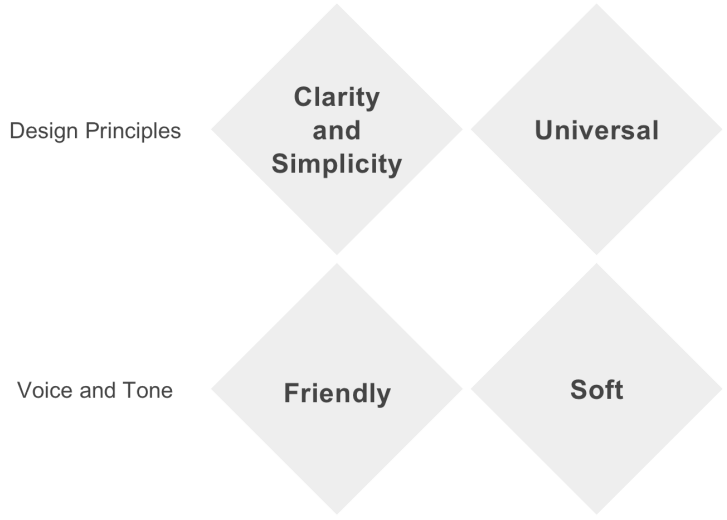

Figure 31. Design principles, voice, and tone of the brand.

4.4 Expanding and refining the design system

When expanding the design system, it is important to keep in mind the ultimate goal of the design system. For this project, these goals were 1) to maximize the efficiency of work while spending limited time and resources, and 2) to ensure consistency in design. These goals helped to expand the design system in the right direction, to improve the quality of the work and develop a product where the user experience is aligned throughout the website.

The design system's parameters become more apparent after the system has started to form into shape. The Oxygen design system does not have strict rules. As the only designer responsible for the design part of the system, it is easy to understand the reasoning behind the creation of each UI component and how they should be applied in different use cases. Therefore more time is spend on creating and updating components as opposed to writing down the gritty details, which can take a lot of time. In smaller teams, the knowledge gaps between designers are less of an issue and it is easier to perform quality assurance compared to larger organizations. As such, defining strict rules is not a necessity. A design system with loose rules also enables the user to think more creatively when using the same components to create a design that suits different purposes.

The system components are designed with modularity in mind. The more compact the components are set, the lesser time is needed to spend on editing and maintenance. The goals are to create a small set of components and re-use them in different ways. The fact that the design system has loose rules also allow this process to be easier.

During the design system development process, the team model stayed centralized. The UI/UX designer is responsible for managing the design related components and the front-end developer takes care of the code related library. Furthermore, the design system operates based on an agile workflow. The project manager receives requests from the client, and the UI/UX designer assesses the requirements and looks for a possible solution using the existing component library. If there is a possible solution that can be done by using the current components, then the UI/UX designer suggests this solution to the client. If the current components library does not provide the possibility to create a suitable solution, then UI/UX designer creates new components and integrates them into the design system. Making changes to components becomes much more straightforward with a design system

that is created based on modularity. For instance, when changes are applied to the smaller components, all larger component with linked elements are automatically updated due to the interconnections between larger and smaller components. Hence, the efficiency of using a modular design system is very apparent as it significantly reduces manual processes and ensures visual consistency of every UI components.

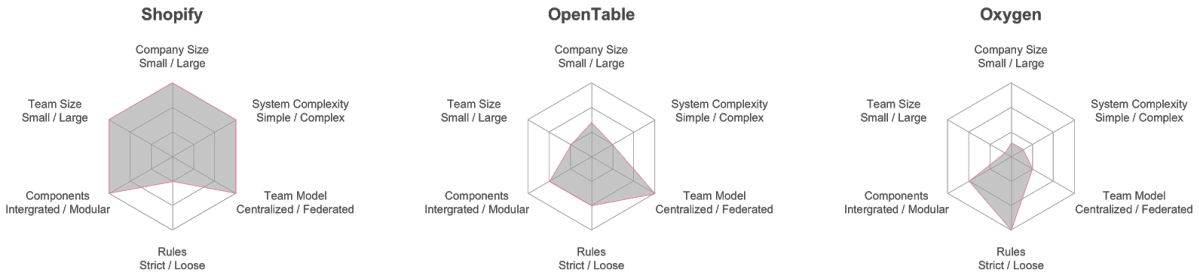

Figure 32. Design system attributes comparison between Shopify's Polaris, OpenTable and the Oxygen design system.

During the development phase of the Oxygen design system, it was decided to make a system that is accessible online, which allows other parties to make use of the design resources as well. The Invision DSM enables this with a built-in feature, which creates an URL after a design system element is created and uploaded to the design system manager. As a result, all components can be shared with third parties, which can reuse them as design and brand materials. Furthermore, it is also possible to invite other stakeholders to collaborate with the design system and therefore the system can be managed by various people at the same time. However, the system is not made entirely public, while many large companies have made their design systems public. For instance, Google's Material Design and Shopify's Polaris design system are made public since these companies have a strong interest in having external developers using their systems and develop on their platforms. For our project, making the design system public to the external users is not considered to be a priority.

5. Discussion and reflection

Before the Oxygen design system was created, there was not a brand book nor style guide for creating a web design. Often, the design was created by previous designs and modifying them to be suited for a new project. This led gradually to noticeable design and user

experience inconsistencies within regular web and campaign pages. In addition, web design, print design, and packaging design are done separately, and as the design knowledge and resources were not shared among stakeholders, this resulted in the brand identity on each medium being inconsistent as well. With the Oxygen design system, design resources and knowledge can now be shared with other stakeholders. Although no co-creating takes place directly through the design system, all stakeholders are now more aware of what the web team is working on and can provide feedback more effectively. Hopefully, this will lead to a more collaborative design process.

After developing the design system, the quality of design increased as well as productivity and consistency. The design process was advancing slowly in the early stages due to time spent on building the foundation of the design system but after a couple of weeks, the design and development process accelerated by utilizing the component library to iterate design quickly. This in turn resulted in huge productivity gains. Making design decisions according to an established structure also saved significant amounts of time spent on experimenting.

The project was challenging but I am happy with the outcome as I learned a lot from the project failures, and there are a few things I wish I would have done differently. Firstly, I wish I would have been more confident in the approach used to build a simple and organic design system. It is easy to become over ambitious when having analyzed various incredibly sophisticated design system that is developed by IBM and Shopify, for instance. Although a simplified and modular component library might not work well for larger organizations it could be well suited for other circumstances. Secondly, I wish I did not spend so much time on fine-tuning the details of the system at the start of the development phase but instead let the system evolve and shape itself as the development process continued.

When I started to build the design system, I had high ambitions and was trying to build the system as perfect as possible. Fortunately, the intensive production phase and workload did not allow me to spend too much time on fine-tuning each component created in the system. Many components were not done correctly at first but were progressively improved instead. Indeed, there is no need to try to make a perfect version of a component every single as it is an irritative process. The design system is a living ecosystem that does not stop evolving.

Furthermore, it is important to keep in mind that a design system is not the final product but rather a tool that when utilized correctly helps to improve the quality of the product. Therefore

the system should be built in such a way that makes it sustainable and manageable to use in the development process.

6. Conclusion

This final chapter summarises the result of this research in the light of the defined research questions by reflecting on my own project experience and the studies done on multiple design systems that are developed by different types of organizations in the e-commerce industry. By doing so, it aims to provide insights into the development process of a design system for potential future developments.

6.1 Findings

The core discussion of this research is surrounded by the topic of whether a design system is only useful to be used in larger teams. What this study shows is that the size of the team is likely to affect the time and resources that can be spent on developing a design system. While the approach and level of sophistication in developing a design system differs for smaller teams vis-à-vis larger teams, using a design system can help a small team to drive the design process and improve the consistency of the final product result. How the design system works in practice for the team is largely dependent on the culture of the organization and its shared values.

Design systems are undoubtedly more praised by larger companies to promote the efficiency of their product development process. However, there are many reasons and benefits for smaller teams for adopting design system into their development process too. First of all, it is easier to change the company culture in a smaller organization. In relation to larger organizations, it is easier to sell the ideas to a smaller team and have them on board with the idea of adopting a design system. A smaller team also means a flatter team structure, which enables efficient development of the design system. As a small team, it is easy to collaborate, and they can work closely with the developer, project manager and the client to receive immediate feedback and iterate quickly to adjust the system according to its specific needs. This leads the system to be often more adaptive. In many instances, smaller teams also require a less complex system than larger teams, as there are fewer demands from

different departments that are using different technologies that should be supported by the design system. In addition, there is less of a knowledge gap within a small team compared to larger development teams, enabling the system to be more straightforward and easier to maintain as well.

The most apparent disadvantage for a small team in relation to a large team using a design system is not having as much time, resources and available budget to allocate to the development of the design system. Especially being the only designer in the team, impedes the development of a more complex system that is often being used in larger organizations. Another drawback for a smaller team is having to make compromises by having to make use of ready-made design system management services. This problem is also related to the limited time, resources and budget constraints that smaller teams often have. For a small team, implementing a design system using standard design system management tools is the most viable approach. However, using standardized tools also means that there may be functionalities that are not customizable to suit the specific needs of the team. Hence, although it saves a significant amount of time and resources for not having to build the tools from scratch, it also comes with limitations in terms of functionality.

6.2 Recommendations

This chapter provides recommendations for small teams on how to approach the development of a design system.

Align team vision

Before starting anything, it is essential to ask your team a few questions. What is your collective vision? What is the most critical problem that the team wants to solve by adopting design system into the development process? Create a clear goal to make it easier to draw a realistic roadmap that is focusing on the most critical aspect of the development process.

Evaluate potential restrains

For a small team, availability of resources are often scarce and as such, it becomes essential to evaluate potential restrains. How much time, resources and budget can be invested in building the design system are all important factors to consider. The goal is to create a better

design instead of a grand design system. Refrain from trying to achieve something that is overly-ambitious for your particular circumstances.

Make use of standard design system management tools

Use standard design system management tools if building a customized tool is not an option for the team. Keep in mind that there are potential compromises to make when opting to use standardized services. If the team can maximize the given functionalities of a standard design system management tool, then this is the best possible approach.

Build a design system around end-user needs

The end users of the system might include the product development team, the client and the business partner that would be working with the system or have access to the component library. The design system will be used much more often if it is created to fit into the workflow of other team members. This can be achieved by interviewing users to identify problems ahead of time and by defining principles that will help others use the system properly.

Start simple

Start from something simple and develop if further step by step. Research and understand the concept of a design system but refrain from following everything that others are doing because their system does not necessarily work in your case. As Christopher Alexander said, “Nothing which is not simple and direct can survive the slow transmission from person to person.” (Alexander, 1979).

Build as you go

Build the system as you go is the most efficient way for a smaller team to implement a design system. Make it part of the design workflow. Refrain from thinking too long term when creating each component. Be comfortable with having an imperfect system as it is never going to become perfect. All that is required testing and iterations.

Be flexible

Finally, use the design system as a tool but keep it flexible. Avoid to trust the system completely; remind yourself that you are the creative individual. Hold back from being grounded by the rules that are supposed to help create better designs, always challenge yourself to think differently.

Appendix

Oxygen Design System Component Library Content

Base	Component	Module	Page
Typography	Product card	Banner module	Home page
Colors	Avatar + Name	1 in a row	Product browse
Button	Input field + button	2 in a row	Product detail
(Style of the button)	Rating stars + comment number	3 in a row	Checkout
Primary	Add to wishlist icon + text	Hero banner	Info page
Secondary	Comment card	Full-width	Article
Tiretary	Community cards	banner	Blog
(States of the button)	Product review card	Alert banner	
Hover	Dermolab card	Comment list	
Focus	Forum card	Product list	
Disabled	Banner	Article list	
Icons	Standard banner	Header	
Logo	Product banner	Footer	
Avatar		Email header	
Spacing		Email footer	
Breakpoints			
Spacing			
Input fields			
(Styles of input)			
Text input			
Quantity input			
Dropdown			
Checkbox			
Radio Button			
(States of input)			
Hover			
Disabled			
Focus			
Error			

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